

Claims

What is claimed is:

1. A method for plating copper on a substrate, comprising adding an anti-oxidant to a plating solution in an amount effective to reduce degradation of organic additives in the plating solution, the anti-oxidant being selected from the group consisting essentially of sodium stannate, hydroquinone, butylated hydroxy toluene, and combinations thereof.
2. The method of claim 1, wherein a concentration of the anti-oxidant is between about 500 ppm and about 5000 ppm.
3. The method of claim 2, wherein the plating solution is configured to support copper plating.
4. The method of claim 2, wherein the plating solution includes copper ions in a concentration of between about 5 g/L and about 100 g/L.
5. The method of claim 2, wherein the plating solution includes an acid in a concentration of between about 5 g/L and about 200 g/L.
6. The method of claim 2, wherein the plating solution includes chloride ions in a concentration of between about 10 ppm and about 200 ppm.
7. The method of claim 1, wherein the amount of anti-oxidant added into the plating solution per unit time is calculated to correspond to an amount of organic additives degrading in the plating solution per unit time.
8. The method of claim 1, wherein the plating solution comprises:
copper ions at a concentration of between about 5 g/L and about 100 g/L;
an acid at a concentration of between about 5 g/L and about 200 g/L;

PATENT

Attorney Docket No.: AMAT/6228/CPI/ECP/PJS

Express Mail No.: EL913563821US

chloride ions at a concentration of between about 10 ppm and about 200 ppm;

sodium stannate at a concentration of between about 500 ppm and about 5000 ppm; and

at least one organic plating additive configured to enhance a plating characteristic of the metal on the substrate.

9. The method of claim 8, wherein the at least one organic plating additive comprises at least one of a leveler, a suppressor, and an accelerator.

10. The method of claim 1, further comprising:
disposing of the entire plating solution after a period of time; and
replacing the plating solution.

11. A method for plating metal on a substrate, comprising:
disposing the substrate and an anode in a plating solution, the plating solution comprising:

metal ions;

one or more organic additives configured to enhance one or more plating characteristics; and

at least one anti-oxidant in an amount effective to reduce degradation of the one or more organic additives; and

plating metal ions from the plating solution onto the substrate.

12. The method of claim 11, further comprising:
disposing of the entire plating solution after a period of time; and
replacing the plating solution.

13. The method of claim 11, wherein the metal ions comprise copper.

PATENT

Attorney Docket No.: AMAT/6228/CPI/ECP/PJS

Express Mail No.: EL913563821US

14. The method of claim 11, wherein the metal ions comprise copper in a concentration between about 5 g/L and about 100 g/L.
15. The method of claim 11, wherein the at least one anti-oxidant is selected from the group consisting essentially of sodium stannate, hydroquinone, and butylated hydroxy toluene.
16. The method of claim 11, wherein the anti-oxidant is sodium stannate at a concentration of between about 500 ppm and about 5000 ppm.
17. The method of claim 16, wherein the plating solution further comprises chloride ions at a concentration of between about 10 ppm and about 200 ppm.
18. The method of claim 16, wherein the plating solution further comprises an acid at a concentration of between about 5 g/L and about 500 g/L.
19. The method of claim 11, wherein the plating solution comprises:
copper ions at a concentration of between about 5 g/L and about 100 g/L;
an acid at a concentration of between about 5 g/L and about 200 g/L;
chloride ions at a concentration of between about 10 ppm and about 200 ppm; and
sodium stannate at a concentration of between about 500 ppm and about 5000 ppm.
20. A plating solution for an electrochemical plating system, comprising:
a liquid solution containing copper ions to be plated on a substrate;
at least one organic plating additive configured to facilitate a plating characteristic of the copper ions onto a substrate; and
at least one anti-oxidant in an amount sufficient to reduce the degradation of the at least one organic plating additive in the plating solution.

PATENT

Attorney Docket No.: AMAT/6228/CPI/ECP/PJS

Express Mail No.: EL913563821US

21. The plating solution of claim 20, wherein the liquid solution comprises copper sulfate.
22. The plating solution of claim 20, wherein the copper ions are at a concentration of between about 5 g/L and about 100 g/L.
23. The plating solution of claim 22, further comprising an acid at a concentration of between about 5 g/L and about 200 g/L.
24. The plating solution of claim 22, further comprising chloride ions at a concentration of between about 10 ppm and about 200 ppm.
25. The plating solution of claim 20, wherein the at least one anti-oxidant is selected from the group consisting essentially of sodium stannate, hydroquinone, and butylated hydroxy toluene.
26. The plating solution of claim 22, wherein the anti-oxidant is sodium stannate at a concentration of between about 500 ppm and about 5000 ppm.
27. The plating solution of claim 20, further comprising;
copper ions at a concentration of between about 5 g/L and about 100 g/L;
an acid solution at a concentration of between about 5 g/L and about 200 g/L;
chloride ions at a concentration of between about 10 ppm and about 200 ppm; and
sodium stannate at a concentration of between about 500 ppm and about 5000 ppm.
28. The plating solution of claim 20, wherein the at least one organic plating additive comprises at least one of a suppressor, leveler, and an accelerator.

PATENT

Attorney Docket No.: AMAT/6228/CPI/ECP/PJS

Express Mail No.: EL913563821US

29. A method for reducing degraded organic plating additives in an electrochemical plating solution, comprising adding sodium stannate to the electrochemical plating solution, the sodium stannate being added in an amount corresponding to a time varying amount of degraded organic plating additives generated in the electrochemical plating solution.

30. The method of claim 29, wherein a concentration of the sodium stannate is between about 500 ppm and about 5000 ppm.

31. The method of claim 29, wherein the electrochemical plating solution is configured to plate copper.

32. The method of claim 31, wherein the electrochemical plating solution includes copper ions in a concentration of between about 5 g/L and about 100 g/L.

33. The method of claim 31, wherein the electrochemical plating solution includes an acid in a concentration of between about 5 g/L and about 200 g/L.

34. The method of claim 31, wherein the plating solution includes chloride ions in a concentration of between about 10 ppm and about 200 ppm.

35. A method for plating copper in an electrochemical plating system, comprising contacting a substrate having an electrical bias applied thereto with a plating solution, wherein the plating solution comprises a copper source, at least one organic additive, and at least one anti-oxidant selected from the group consisting of sodium stannate, hydroquinone, butylated hydroxy toluene, and combinations thereof.

36. The method of claim 35, wherein a concentration of the sodium stannate is between about 500 ppm and about 5000 ppm.

PATENT

Attorney Docket No.: AMAT/6228/CPI/ECP/PJS

Express Mail No.: EL913563821US

37. The method of claim 36, wherein the plating solution includes copper ions supplied by a copper sulfate solution, wherein the copper ions are in a concentration of between about 5 g/L and about 100 g/L.

38. The method of claim 36, wherein the plating solution includes an acid in a concentration of between about 5 g/L and about 200 g/L.

39. The method of claim 36, wherein the plating solution includes chloride ions in a concentration of between about 10 ppm and about 200 ppm.

40. The method of claim 36, wherein the amount of anti-oxidant added into the plating solution per unit time is calculated to correspond to an amount of organic additives degrading in the plating solution per unit time.